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Design, Synthesis, Aqueous Properties and Investigation of Novel Cationic Surfactants as A Long Term Green Corrosion Inhibitors Exposure

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ABSTRACT

A novel series of cationic surfactants namely: 1-(2-Aminoethyl)-2-octadecyl-imidazoline (A), N-Benzyl-N,N-dimethyllaurayl -1-aminium chloride (B) and N-Benzyl-N,N-dimethylmyristyl -1-aminium chloride were synthesized, characterized and evaluated as a corrosion inhibitors. These prepared cationic surfactants possess very interesting physical properties such as good flow which make them suitable for the injection through the gas raw pipeline. The results showed that newly formulated surfactants prepared from A, B and C showed a good ability to act as water soluble types, no-foaming and stable film-persistent corrosion inhibitor for the thermodynamic-hydrodynamic corrosivity predictive models for the assessment of internal corrosion /erosion in the surface production pipelines (flow lines and gathering lines). Furthermore, the newly formulated showed strong antibacterial more than other commercial biocide samples.

Keywords: Fatty acid derivatives, gas pipelines, Corrosion inhibitor, protective films, Biocide.

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INTRODUCTION

Corrosion is a major economic problem for all industrialized countries exist widely in various industrial fields, mainly in petroleum industrial resulting in huge economic losses[1]From 25 to 30% of the total economic losses in the oil and gas industry [2] so Corrosion has a very important economic impact in the petroleum industry[3] Several types of corrosive environments are encountered in the petroleum industry.CO2 corrosion is recognized as a major factor for the failure of oil and gas pipe lines[4], Carbon dioxide (CO2) is a naturally occurring constituent in oil and gas production and is found in amounts varying from trace levels to as much as 50%. These problems have caused the consideration of many corrosion control methods and research in various oilfields around the world. The corrosion inhibitors can be classified in general, the inorganic inhibitors have cathodic actions or anodic. The organics inhibitors have both actions, cathodic and anodic and the protective by a film adsorption. the classification of the inhibitors shown on Fig. 2 [5]The application of corrosion inhibitors is one of the most effective and economical methods to protect metal represent flexible means of corrosion control in current and future, The need to produce and transport oil and gas under increasingly more severe operating conditions[6-9] In recent years, with improved recognition of environmental protection, development of green petroleum additives has received increasing attention, because the petroleum industry development needs to design new families of environmental of additives.[10-14] ,So Many inhibitor formulations have been developed for use in corrosion control. amines- and imidazolines-derivatives are extensively used as an active component in commercial corrosion inhibitor formulation and packages For its high efficiency and low toxicity, represent the most economical and effective ways[15-16] ,the quaternary salts of fatty acids on the imidazoline-type inhibitors, Imidazoline based corrosion inhibitors are well known to have high corrosion inhibitor activity in acidic medium caused by corrodents such as carbon dioxide other corrosive gases such as hydrogen sulfide in aqueous phase and therefore are used to minimize carbon dioxide induced oil and gas field corrosion[17,9]. Corrosion inhibitors based on organic substances are the most practical methods for protection of carbon steels mainly due to economic reasons [1-3].It is generally accepted that organic molecules inhibit corrosion via adsorption at the metal surface and form protective films, which can isolate the metal from corrosive medium. The mode of adsorption is dependent on the following factors: structure of the molecule, solution chemistry, characteristics of the metal surface and electrochemical potential at the interface. Such as functional group type, Four primary modes of adsorption are associated with organic compounds at surfaces: electrostatic adsorption, back bonding, chemisorption, and organometallic complex formation [3,7,18,19] fatty acids, amines, imidazolines, oxyalkylated amines, oxygen, sulphur or phosphorus containing species, quaternary amines) and long hydrocarbon chain (typically C14 - C18) containing different polar hetero-atoms (N, O, P, or S) of high electron density and hydrophobes of long alkyl chains are efficient corrosion inhibitors. Polar hetero-atoms help them to chemisorb on metal surfaces resulting formation of protective surface complexes ,These inhibition processes involves the chemisorption of the nucleophilic heteroatom on the metal surface which in turn is shielded by the hydrophobes from the hostile aqueous medium[20,21].the imidazoline ring can adsorb on metal Fe surface by donating electrons to metal atoms and accepting electrons from 3dorbital of Fe atoms Some researchers believe they block the active sites and generate a barrier to reduce the transport of corrosive species to the metal surface, the mechanism of corrosion and adsorption of imidazoline on the surface of mild steel as showed in Fig. 2[22,23] Calculation of chemical adsorption energy between imidazolines and the Fe atom by quantum chemical methods was studied[24],Oleo imidazoline organic inhibitors work by this adsorption mechanism. The structural characteristic of inhibitor imidazoline film is greatly dependent on the structure of inhibitor molecule, such as functional group type and chain length, due to the impact of this groups on disperse, diffusion, solubility and adsorption of the imidazoline molecule. They are commonly used in conjunction with an acid at pH 4 or less in aqueous systems. Imidazoles have occupied a unique position in heterocyclic chemistry, and its derivatives have attracted considerable interests in recent years for their versatile properties in chemistry and biology. The imidazole derivatives possess extensive spectrum of biological activities such as antibacterial and antifungal [25-26]. Imidazoline derivative partially inhibits the formation of iron-oxidizing bacteria biofilm [27], Imidazolines will hydrolyze in water when present in the non-neutralized form so the prepared cationic imidazoline which act as cationic surfactant become more stable. These prepared cationic surfactants can adsorb on the metal surface through the formation protective film, some researchers believe that the mode stability of the adsorption film is dependent on structure of the molecule, some other researchers believe they also dependent on characteristics of the metal surface and electrochemical potential at the interface. However, there is few reports about the effect of flow velocity, slug flow, water condensate and sand production, under both of the current thermodynamic (temperature and pressure) and hydrodynamic (multiphase flow) operation conditions on the stability of the adsorption protective film.

In the present study we investigated the inhibition effect of A novel series of cationic surfactants for carbon steel corrosion in Multiphase flows, The focus of our current research was the Design, Synthesis, Aqueous Properties and Investigation of the quaternary ammonium salts of fatty acids (lauryl (C12), myristyl (C14) and oleyl : C18 unsaturated) as a long term corrosion inhibitors exposure in aggressive salt, sand and sludg contaminated aqueous solutions saturated with carbon dioxide at high flow rate and clay deposits.

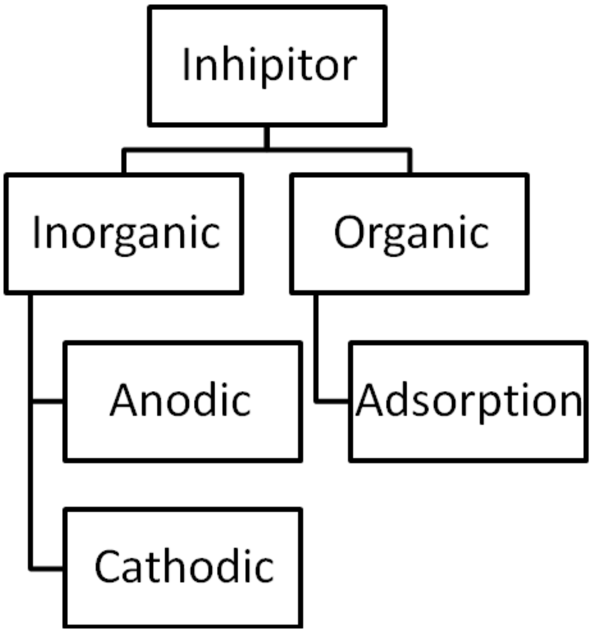


Figure 1: Classification of inhibitors.

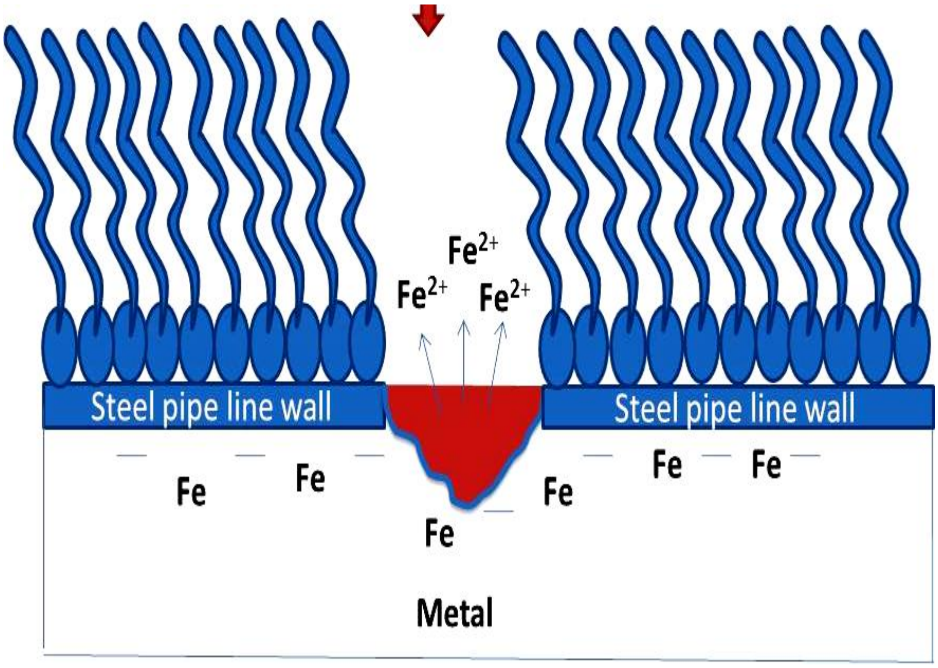


Figure 2: Sketch of adsorption of imidazoline corrosion inhibitor on corroding Fe surface.

Nomenclature

PPM: Parts per million
Mpy: Mils penetration per year
MMSCFD: Million standard cubic feet per day

LPG: Liquefied petroleum gas
OA: Oleic Acid
DETA: Diethylenetriamine
OIs: Oleic Imidazolines
OA/DETA: Oleo ImidazolineDiethylenetriamine
C12/C14 DMA: lauryl/myrictyl Dimethyl amine
CNG: Compressed natural gas
AM: Antimicrobial Analysis
PDMS: Polydimethylsiloxane
BBLS: Barrels BBLS stands for Barrels
CR: Corrosion rate

Experimental and experimental methods

Carbon steel

The chemical composition of carbon steel was the following 0.16 C, 0.26 Si, 1.30 Mn, 0.010 S, 0.009 P, 0.05 Nb , 0.026 Al,0.007 Co, 0.013 Cu, 0.014 Cr and the remainder iron determined by an ARL™ 4460 Optical Emission Spectrometer(USA),

Gas Production characteristics

Characteristics, Experimental conditions for corrosion measurements and Analytical data of the Assessment of internal corrosion in the surface production pipelines of the gas well indicate that the thermodynamic corrosivity predictive model has found that, under the thermodynamic operating conditions in the full length of the pipeline, the corrosivity of the flowing fluid due to carbon dioxide (0.4-0.5mole% , 3.42-5.64 psi partial pressure) is rated as slightly corrosive with a possibility to cause general pitting to the carbon steel of the pipeline .the thermodynamic- Hydrodynamic prediction model established based on multiphase flow for the pipelines found that, for the whole length of the pipeline, the multiphase mixture flow velocity is always above both of the API-14E critical velocity and the service velocity limit for sand erosion, and therefore neither flow induced corrosion (erosion corrosion by liquid droplets impingement)nor sand erosion is predicted to occur.

Weight Loss Techniques

The carbon steel sheets of 7 cm 9.3 cm 0.5 cm were sequentially abraded with different emery papers cleaned successively with distilled water, ethanol and acetone and finally dried in dry air at room temperature 25. After accurately weighing, the steel specimens were immersed in the CO_2-saturated corrosion 28 solution in 1000 mL PE bottles. The specimens were completely immersed for 12-120 h, with the addition of different concentrations of the synthesized cationic surfactant formula at 50 C°. The experiments were carried out in triplicate to get good reproducibility. The weight loss then was determined and the corrosion rate was expressed and the average value of the weight loss is reported. The specimens were sequentially abraded with different emery papers, degreased with acetone, washed with distilled water and dried. Corrosion parameters such as corrosion rate (CR) and inhibitor efficiency were calculated in the absence and presence of the cationic surfactant corrosion inhibitors at concentrations ranging from 50 to 200 ppm.

Characterization

The FT-IR spectra of (C12/C14 DMA) and C12/C14 Dimethyl ammonium chloride were recorded using BRUCKER spectrophotometer using KBr pellet with spectrum of wave number range 4000–400 $cm^{-1}$with an accuracy of 2 cm^{-1}.

Synthetic method

Preparation of oleo imidazoline

73.33 g (0.26 malls) of oleic Acid (OA) was placed in a 250 ml, 4-neck round bottomed flask equipped with an overhead stirrer, thermometer, addition funnel and a Dean-Stark trap. The (OA) was heated to 60° C in the presence toluene 30 as isotropic solvent. and then 26.67 g (0.25 malls) of Diethylenetriamine was added drop wise. The resulting mixture turned from light yellow to dark red with remarkable increase in viscosity and exothermed to 100° C to form ammonium salt neutralization. The mixture was then heated to 133°-143° C. for 3.5 hours to form amide. The hydrocarbon collected in the trap was returned to the flask. The mixture was thereafter heated to 160° C. for 1 hour while allowing water to collect in the Dean-Stark trap to completely of amid step. The resulting mixture was then heated at 165° C. for 2 hours and then at 240° C to allow to formation imidazoline ring OA/DETA imidazoline, for an additional hour during which time any further evolved water was collected. A nitrogen sweep was applied and the speed of the overhead stirrer was increased to facilitate removal of water. Following further heating of the mixture to 230° C. for an additional 1.5 hours, the reaction mixture was cooled and 50 g of the resulting oleo imidazoline 1-(2-Aminoethyl)-2-octadecyl-imidazoline was then reacted with 25 g of acetic acid which was carefully added dropwise to the imidazoline product to form cationic imidazoline. A temperature rise of about 70-89° C. was observed, Molecular structure of the prepared OA/DETA imidazoline, are shown in Fig. 3, the final products were investigated in this reaction. Following the progress of formation oleo-amid and oleo-imidazoline ring, average yield of oleo-amid and oleo-imidazoline ring will increase, accompanied by increase of water collecting in the Dean-Stark trap, Therefore the progress of amide and imidazoline ring OA/DETA imidazoline step could be reflected by the change amount of water to collect in the Dean-Stark trap to completely of final product.

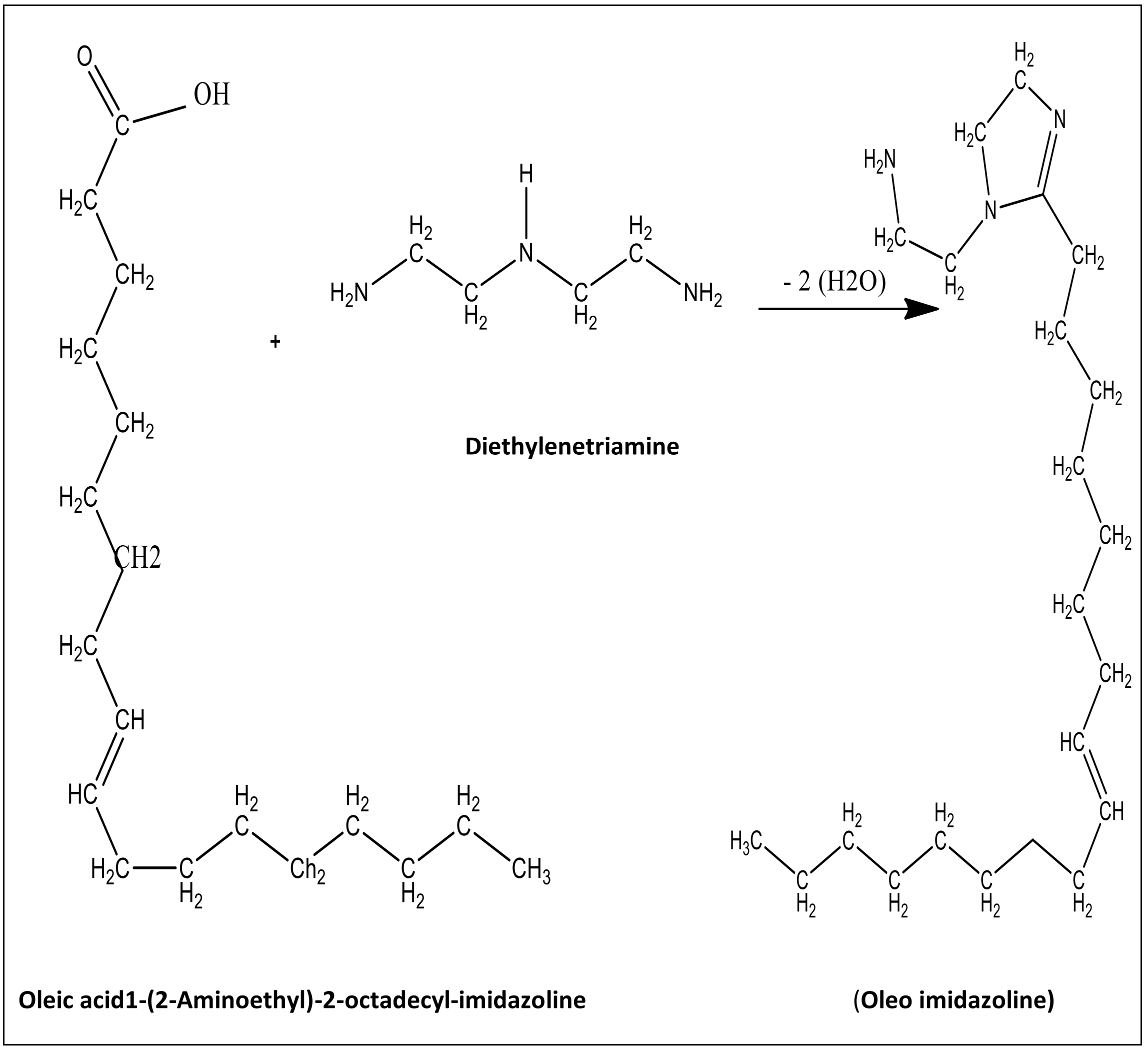
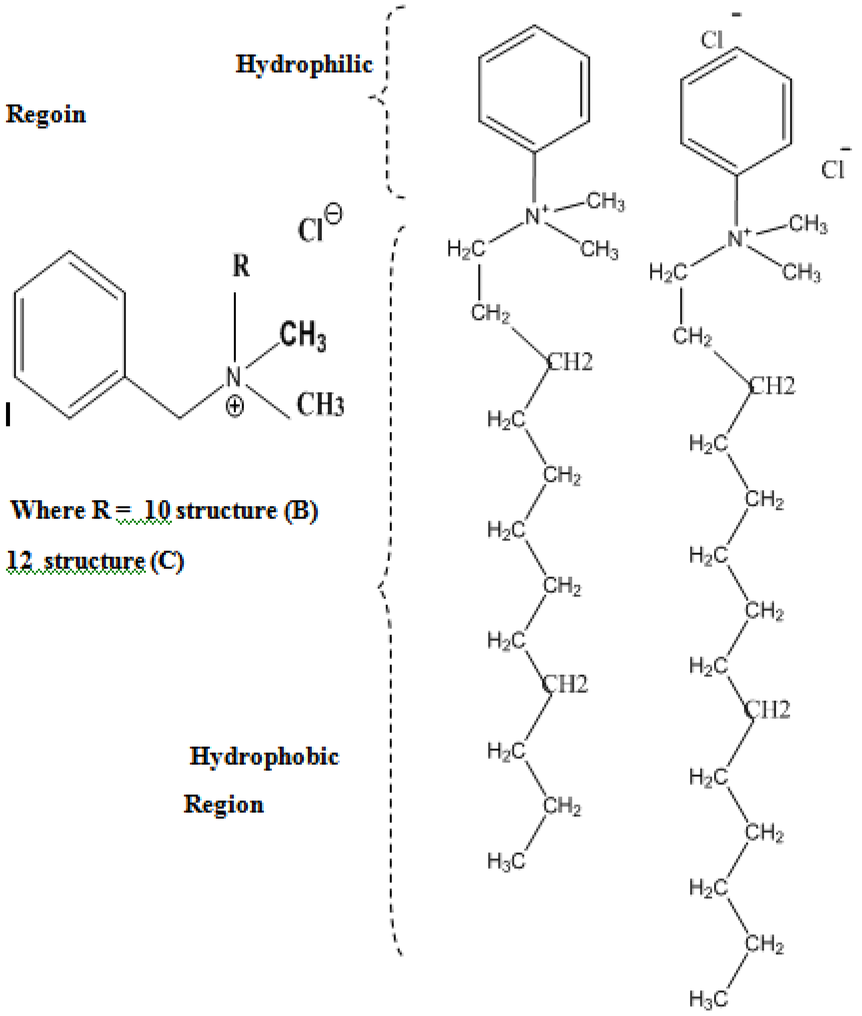


Figure 3: The Molecular structure of the prepared OA/DETA imidazoline

Preparation of a quaternized C12/C14 Dimethyl ammonium chloride

Place 190.47 grams represent one mall from C12/C14 dimethyl amine (30:70) and a magnetic stir bar into a 1000 ml 4-neck round bottomed flask that was partially submerged in controlled temperature water bath, a reflux condenser and equipped with magnetic stirrer, a nitrogen inlet thermometer and heater, Add 126.58 grams about one mall of Benzyl chloride to the flask with slowly addition. Stopper the flask tightly and heat its contents to 80° C. Maintain the temperature of the flask contents at 80° C. for 6 hours while stirring. The resulting product mixture will contain a high yield of quaternized C12/C14 DMA used as Biocide. the product is a nucleophilic substitution reaction of alkyldimethylamine with benzyl chloride [27], General Molecular structure of prepared cationic surfactants mixture from N-Benzyl-N,N-dimethyllaurayl -1-aminium chloride and N-Benzyl-N,N-dimethylcetyl -1-aminium chloride can be seen in Fig. 4



(General cationic surfactant A) (Cationic surfactant B) (Cationic surfactant C)

Figure 4:The molecular structure of the synthesized quaternary ammonium salts (C12/C14 Dimethyl ammonium chloride).

Preparation of Quaternary amine-cationic imidazoline corrosion inhibitor formula

For preparation of water soluble, no-foaming, stable film-persistent corrosion inhibitor adequate for WASCO line field trial the prepared newly formulation contained A novel series of cationic surfactants namely: 1-(2-Aminoethyl)-2-octadecyl-imidazoline (A), N-Benzyl-N,N-dimethyllauryl -1-aminium chloride (B) ,N-Benzyl-N,N-dimethylcetyl -1-aminium chloride in addition to polydimethylsiloxane (EBCABURST-200) and Hydrazine. compound (A) is acationicimidazoline OA/DETA imidazoline (oleo imidazolineDiethylenetriamine) main compnanant corrosion inhibitor,C12/C14 Dimethyl amine quaternary Benzyl chloride as biocide, antifoam silicon base (EBCABURST-200), solvent (iso propanol) and Hydrazine which have an important role in corrosion inhibitor formula by neutralizing acidic carbon dioxide or by shifting surface pH towards less acidic and corrosive values.in general amines such as morpholine, hydrazine, ethylene amine or diethylenetriamine are transported with gas steam to prevent corrosion in the condenser tubes.

RESULT AND DISCUSSION

Aqueous properties, analytical data and antimicrobial study for C12/C14 dimethyl ammonium chloride against microorganisms

Bacteria Controlled Environment Against both aerobic and anaerobic microorganisms is needed in Corrosion, including injection and work over fluids. Many cationic emulsifiers such as quaternized C12/C14 Dimethyl ammonium chloride have multifunctional properties enable them to use as corrosion inhibitor, sulphurous and oxygen scavenger, oil-wetting agents, ph adjuster , demulsifier/sludge breaker for enhanced oil extraction and Provides supplemental emulsion stability in oil emulsions at high different temperatures [29-33], it is safe, rapid and acting as bactericide, algaecide , fungicide [34] .it is have powerful antimicrobial activity at low dosage (ppm), it is also Compatible with Non-ionic, Ampholytic and Cationic surface-active agents. The greatest biocidal activity due to their cationic amphiphilic property, having a distinct hydrophobic and hydrophilic region, resulting fromnucleophilic substitution of alkyldimethylamine and benzyl chloride, quaternized C12/C14 Dimethyl ammonium chloride hydrophilic cationic region destabilizes the pathogen's surface, mechanism of bactericidal/microbicidal action is thought to be due to disruption of intermolecular interactions. This can cause dissociation of cellular membrane lipid bilayers, which compromises cellular permeability controls and induces leakage of cellular contents.by forming electrostatic interactions with negatively charged components .The effect of quaternized C12/C14 Dimethyl ammonium chloride is to damage the pathogen's membrane, thus for bacteria, disrupting essential cell processes like ATP synthesis or solute uptake [35,36,37] in addition to enzyme disorder and lack of protein synthesis. This series is involved in the comparative study between quaternized C12/C14 Dimethyl ammonium chloride and some other commercial Biocide samples such as MERGAL® and ISOCINRNR14 .the results showed in Table 1.indicate that Quaternized C12/C14 Dimethyl amine showed strong antibacterial more than other commercial biocide samples MERGAL® and ISOCINRNR14 the prepared cationic surfactant C12/C14 Dimethyl ammonium chloride have Extreme effect on microorganisms (Escherichia coli ATCC13706, Pseudomonas aeruginosa ATCC15442, Listeriamonocytogenes ATCC25152 Staphylo-coccusaureus ATCC6538),Thus can be used as antimicrobial in the newly corrosion inhibitors formulation.in addition to their compatible with nonionic, ampholytic and cationic surface active agents .so It is widely used in many other formulations such as cleaner , sanitizers for dairy industry , food storage, cosmetics, pharmaceutical and paints . The their Antimicrobial activity of C12/C14 Dimethyl amine showed in Table 1

Samples	**Tested bacterial strains**			
	E.Coli ATCC13706	**Pseudomonas aeruginosa ATCC15442**	**Listeria monocytogenes ATCC25152**	**Staphylococcus aureus ATCC6538**
MERGAL®	++	+++	++	++
ISOCINRNR14	+++	+++	++	++
C12/C14 DMA Q.bcL	++++	++++	++++	+++

Where *(++) Moderate effect on microorganisms; *(+++) High effect on microorganisms; *(++++) Extreme effect on microorganisms

Characterization FT-IR spectra of C12/C14 Dimethyl ammonium chloride

The FT-IR spectra of C12/C14 Dimethyl amine (C12/C14 DMA) and Quaternized C12/C14 Dimethyl amine are shown in Fig. 6. and Fig. 7. The spectrum of C12/C14 DMA shows a broad band at 3439 cm^{-1}that can be assigned to the stretching vibration of N H groups. The bands at 2923 $cm^{-1}$and 2851 cm^{-1}correspond to C H stretching of aliphatic group, the absorption band at 1644 cm^{-1} can be attributed to the CN stretching in amine groups. The N H bending in amine groups were observed obviously at 1550 cm^{-1}.Other major bands observed in Cs were found at 1380 cm^{-1} (amine III band, CN stretching vibration), 1314 cm^{-1} (CN stretching vibration), 1152 cm^{-1} .The FT-IR spectrum of Quaternized C12/C14 dimethyl ammonium chloride shows all the significant characteristic bands of both (C12/C14 DMA) and benzyl chloride with shifts in the position of the bands. Some bands were shifted to longer wavenumbers such as the band at 858cm−1of (C12/C14 DMA) to 878 cm−1 and the bands at 1442 cm−1and 1103 cm−1of (C12/C14 DMA) were shifted to1455 cm−1and 1106 cm−1, respectively. On the other hand, other bands were shifted to shorter wavenumbers such as the bands at1652 and 1033 cm−1of Cs to 1634 and 1022 cm−1, respectively. The broadening and the shifting of the latter band can be assigned to the electrostatic forces between the moieties of (C12/C14 DMA) and benzyl chloride. In accordance with the aforementioned IR results, it can be concluded the electrostatic forces are the driving forces for the interaction between the moieties of (C12/C14 DMA) and benzyl chloride which indicate that formation of quaternary ammonium salt.

Table 2: Physical Properties of prepared a quaternized C12/C14 dimethyl amine (Q.bcL) compound

Items	Index
Appearance	Colorless to yellowish transparent liquid
Active content %	80%
Amine salt %	1.0
PH(1% water solution)	7.0
Density	0.97(±0.01) g/Ml

Aqueous properties and analytical data of defoamer EBCA BURST-200

Polydimethylsiloxane (PDMS oil) widely used in many industrial application as defoaming agent, their hydrophobically modified particles are dispersed in the oil to increase antifoam efficiency [38] EBCABURST-200 is Highly efficient silicone polydimethylsiloxane emulsified by mixture of high and low HLB nonionic emulsifiers, used as defoamer in the newly our corrosion inhibitor formula this defoamer have efficient and stable in wide temperature range, effective in all types of processing equipments, leaving no scum and Avoid spots on internal surface of production pipelines, also This product have sufficiently stable to shear, chemicals, temperature and pH to prevent effects such as scum formation, silicone accumulation. EBCABURST-200 is the suitable product. Unlike many other silicone defoamers, EBCABURST-200 is stable in baths containing high concentrations of electrolytes from a variety of sources in addition of all EBCABURST-200 can be mixed well with any of corrosion formula, also can be dilute at the use by amount 5 times with water before adding it to the formula in the other hand, Silicone Polymers ready to biodegradation in nature by soil microorganisms [39,40]which make it the suitable type in green corrosion inhibitor formula. The needed to defoamer because almost of quaternary ammonium compound formed a huge foams in aqueous media during the filling in the chemical skid and injection.

Table 3: Aqueous properties and Analytical Data of Silicon base Defoamer EBCA BURST-200

Property	EBCABURST-200
Appearance	Opaque white liquid
Chemical	Silicon emulsion
Ionic charge	Nonionic
PH	7 – 8
Concentration level	High

Aqueous properties and Analytical Data of quaternary amine-cationic imidazoline corrosion inhibitor formula

Aqueous properties Analytical Data samples of Quaternary amine-cationic imidazoline water soluble type, no-foaming, stable film-persistent corrosion inhibitor formula for raw gas Production with associated water and its properties at the solution/air interface were investigated by measuring dynamic viscosity (Cp) at low and pediment temperatures, Pour point(°C), density at 40°C, Refractive index at 20°C and pH using standard test methods are shown in table 4

Which indicate that Quaternary amine-cationic imidazoline corrosion inhibitor have optimum properties for the filling in the chemical skid during field trials corrosion inhibitor long term exposure. The evaluate fluid properties have an important role in the recommended dosage for each well field trial conditions to customize a corrosion-treatment program specific to The chemical injection rate optimized needs. Further investigation was conducted based on FTIR spectra for three sample called EW#3,Bassoat -3 and Bassant #1 samples corrosion inhibitor three samples were prepared almost identical which shown in

Table 4: Result of analysis for corrosion inhibitor Bassant #1well

Experiment	Method	Result
Dynamic viscosity, cp, @ 15°C	ASTM D-445	37.0
Dynamic viscosity, cp, @ 25°C		22.8
Pour point, °C	ASTM D- 97	-15
pH		7.21
Density @ 40°C	ASTM D-1298	0.9975
Refractive index @ 20°C	ASTM D-1218	1.424

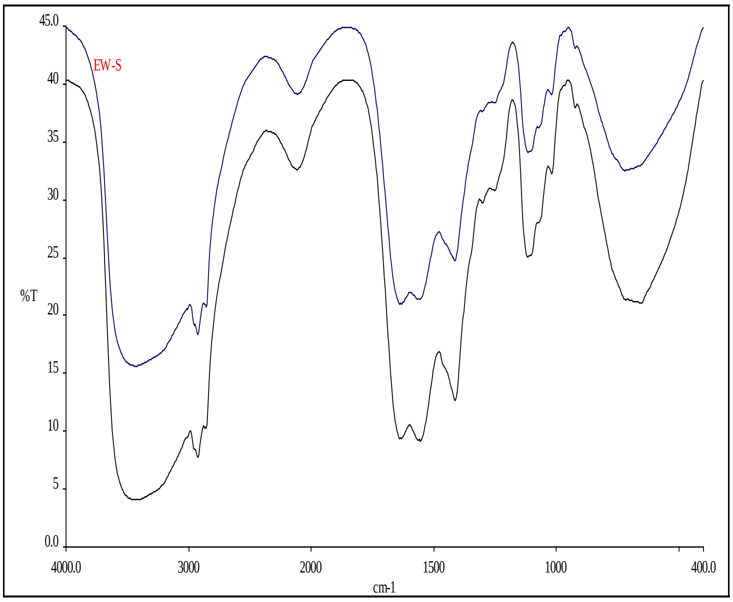


Figure 5: FTIR spectra corrosion inhibitor sample from EW-5 and Bassoat -3 batch

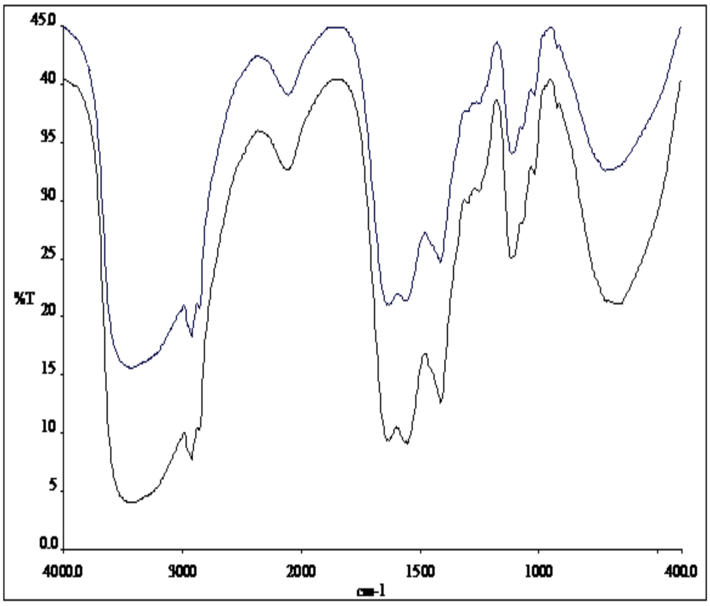


Figure 6: FTIR spectra corrosion inhibitor sample from EW-5 and Bassant #1 samples

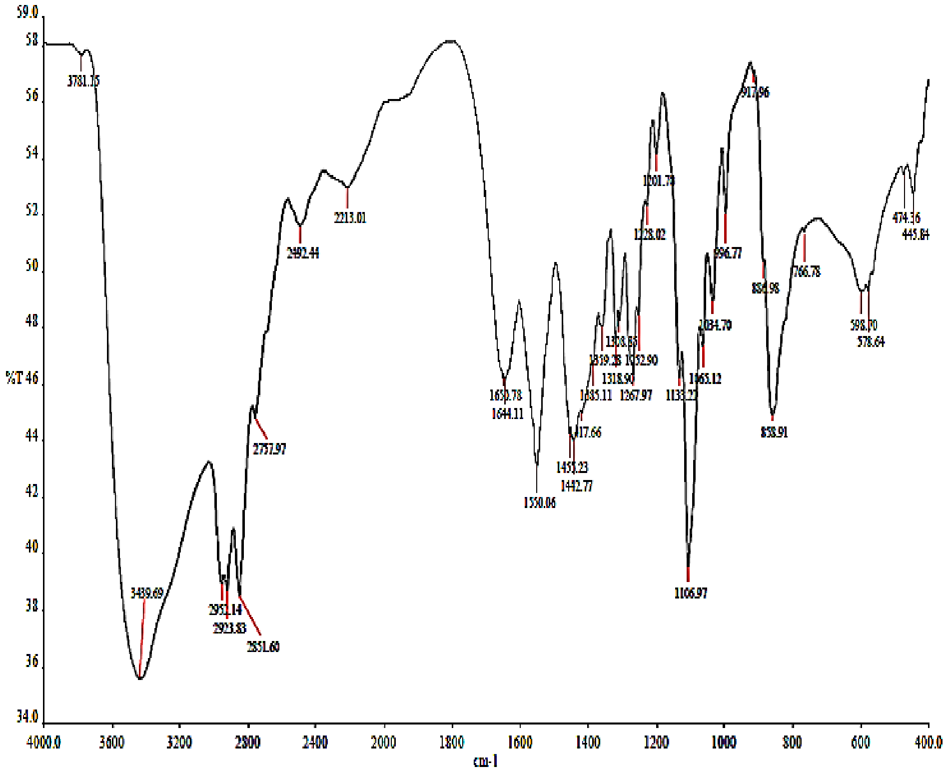


Figure 7: FTIR spectra C12/C14 DMA

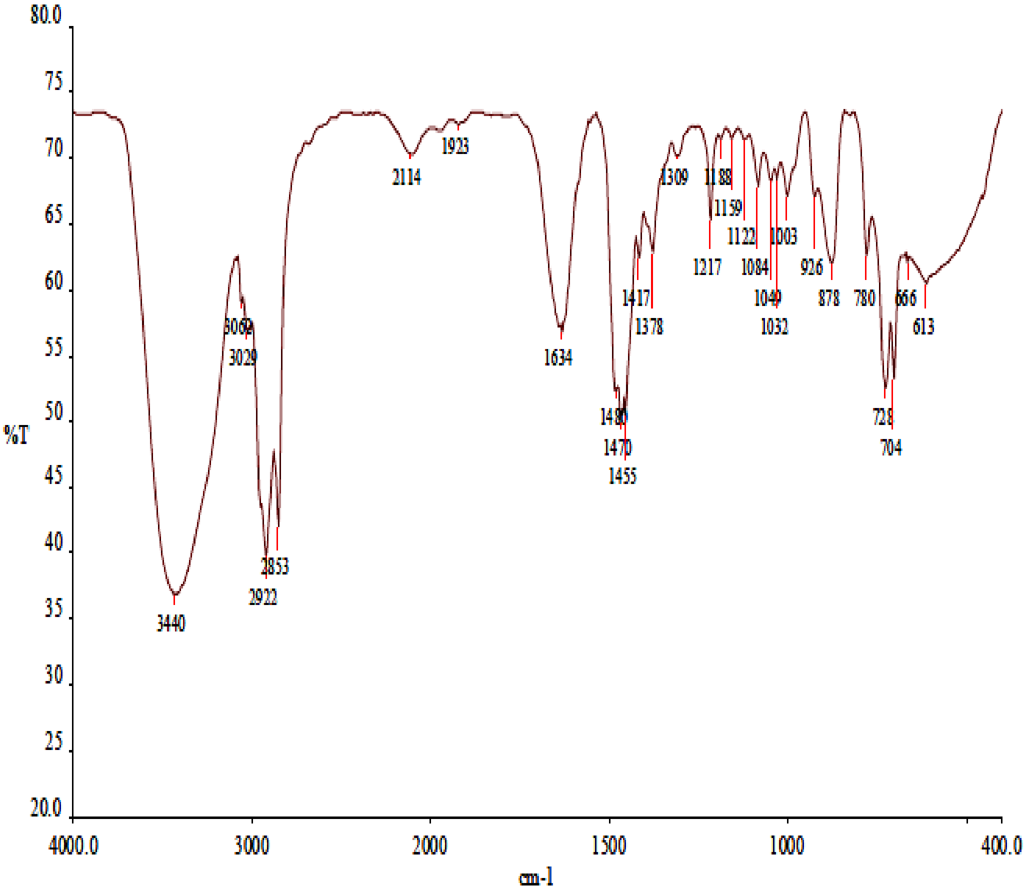


Figure 8: FTIR spectra of cationic C12/C14 DMA

Laboratory Evaluation of Quaternary amine-cationic imidazoline corrosion inhibitor

Imidazoline derivatives, a kind of environmental-friendly corrosion inhibitors, can effectively inhibit metals corrosion in CO2 environment Corrosion test have been carried out in formation water at 50 C° is shown in Table 7.in the absence and presence of inhibitor using static and linear polarization (L.P) methods. The Table 7 clearly shows that the inhibition efficiencies increased with the increasing concentration at 50°C.suggesting that OA/DETA imidazoline forms an inhibitive film on the metal Fe surface. [41] The increasing number of molecules of inhibitor covering the surface area of metal with the increase of its concentration resulted in a decrease of the corrosion rate and increase of inhibition efficiency. Generally it is assumed that the first step of the inhibition of aggressive media is the adsorption mechanism of the inhibitor at the metal/solution interface. Some types of adsorption of organic molecules at the metal/solution interface are mentioned by the following: (1) electrostatic interaction between the charged metal and the charged molecules, (2) interaction of uncharged electrons pairs in the inhibitor molecule with the metal surface, (3) interaction of π-electrons with the metal and (4) combination of (1) and (3) [42,43]. The newly formula represent an environmental alternatives and effective for the protection of metallic surfaces against corrosion, adsorption of used compounds was found to obey Langmuir isotherm [44,45].

Table 5: Laboratory Evaluation of Quaternary amine-cationic imidazoline corrosion inhibitor

Method	Blank Corr. Rate, mpy	% Inhibition, at:		
		50	100	200 ppm
Static	2.3	28	54	36
L.P	49	-47	16	12

Investigation of Oleo Imidazoline as Long Term Corrosion Inhibitor Exposure (CORRICHEM field trial)

Conclusion of Corrosion inhibitor CORRICHEM field trial, Concerning start up Quaternary amine-cationic imidazoline Corrosion Inhibitor the chemical injection skids of EW-5,Bassant #1 and Bassoat-3 wells were filled with batch treatment (140 Lt/ 24 hours at EW-5,Bassant #1 and (100LT/ 24hours at Bassoat -3 and the chemical injection rate optimized to (2 Pint/Day; based on each well production) as continues treatment injection and the coupons had been installed for at injection 2 pint/MMMSCF for 30 day (total trial day).The carbon steel coupons are weighted and installed for the trilled wells at the end of each flow line. The cleaning and calculations for coupons were done by lab staff and the results are showen in Table 8.wich indicate that the efficiency of corrosion inhibitor CORRICHEM the corrosivity fluids being currently handled in the surface production pipelines (flow lines and gathering lines) of the gas wells depend on the chemical and physical properties of the produced gas, water condensate and sand production, under both of the current thermodynamic (temperature and pressure) and hydrodynamic (multiphase flow) operation conditions in these pipes. Where that the newly formulation CORRICHEM compound showed a good efficiency as corrosion inhibitor in both EW-5 and Bassoat -3 well, and moderate in Bassant #1 the reason should be attributed to the increasing of flow rate in the last well Bassant #1well which causes the greet internal corrosion/erosion in the surface production pipelines. The flow enhanced corrosion which is associated with slug flow, slug flow can drastically cause severe corrosion in pipes by removing the protective film on wall of the pipe there about by the shear forces caused by the high turbulent mixing zone of the slug which develops region of high shear forces in the slug which can destroy the boundary layer close to the wall. This situation causes the stripping off the protective layer present on the metal surface of the pipe wall by slug, which in turn leads to increase in corrosion rates. Also this situation makes the formation a stable inhibitor film difficult and the slug flow thus drastically reduce the effectiveness of the corrosion inhibitor films. The slug flow could occur at any orientation of the pipe depending on the inclination angle, altitude, topography and geometry relation to the pipe. Therefore, flow enhanced corrosion could take place at Bassant O'clock positions depending on where the slug is exerting shear to the well of the pipe. So the main concern with the flow enhanced corrosion associated with the intermittent slug flow regime is that, this corrosion form could result in the penetration of the wall of the pipelines.

Table 6: Field trial Quaternary amine-cationic imidazoline corrosion inhibitor Evaluation

Well Name	Average Corrosion Rate (MPY)	Corrosion rate	Status
EW-5	0.0524 (low)	LOW	Technically Accepted
Bassoat-3	0.2989	LOW	Technically Accepted
Bassant #1	1.3575	Moderate	Not Technically Accepted

CONCLUSIONS

A series of quaternary ammonium salts were successfully synthesized and characterized by FTIR, Surfactant C12/C14 Dimethyl ammonium chlorides have been obtained with good yield after short reaction times in the presence methanol as solvent. Properties of these prepared cationic surfactant, including Dynamic viscosity, Pour point, pH, density, melting points, solubility and antimicrobial activity have an important role for the injection through the gas raw pipeline gas The results showed that newly formulated showed good corrosion inhibitors for production pipelines in oil and gas wells applications. The inhibition efficiency of these prepared cationic surfactants increases with increasing the concentration at 50°C. The efficiency of corrosion inhibitor corrichem in the surface production pipelines of the gas wells depend strongly on the chemical and physical Properties of the produced gas, water condensate, clay deposits and sand production under both of the current thermodynamic and hydrodynamic operation conditions in these pipes, The addition of antimicrobial agents have an important role in formulation of long term Corrosion Inhibitor exposure increase amines and their derivatives molecules in formulation lead to the increase antimicrobial activity and long term storage [46,47].

However, more work is required, both to better understand the potential scope of their properties and to broaden the range of materials in this family of salts to become make strong adsorption on inner surface of production pipelines gas well at high flow rate in the presence slug flow to decrease and control corrosion/erosion in the surface of production pipelines.

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